

Scandium: go ahead, make my day.

☒ What do Clint Eastwood and rare earths have in common? Most sensible people would be correct in thinking 'not much'; however, a rare handful of those – rarer than are heavy rare earths- might recall a movie steeped in Cold War iconography: "Firefox".

The film tells the story of an American military operative, played by Mr. Eastwood, who visits the Soviet Union on a mission to steal a Mach-6 capable military fighter jet, combining twice the speed of an SR-71 with the agility of an F-16 and the mind reading characteristics of the Amazing Kreskin. Evidently, it posed a real threat to the NATO block. The movie was based on a novel written in the mid-70's and despite some over the top scenarios, the story did capture an actual concern that Soviet engineers had gained technical superiority in some aspects of aerospace design. That concern was aroused by the MiG 29 and MiG 31 'Foxhound' (the actual Mach 3.2 capable aircraft that inspired 'Firefox') that were considered to be too advanced for comfort. Specifically, NATO engineers were curious about the Soviet aerospace sector's expertise with scandium, not strictly classified as a rare earth metal, but often considered as such due to its rarity and properties.

Scandium is the eighth rarest element on Earth (it can often appear in meteorites) and it is a powerful refiner of particles, which when added to aluminum alloys increases its strength and durability by 50% (almost twice as strong as aluminum series 6061 or 7005), in turn allowing for the use of less material to achieve the desired characteristics, translating to less weight. For an additional comparison, consider that if a carbon structure were to have the ability to withstand the same rigors as a scandium alloy, it would end up being heavier

than the scandium structure itself. Scandium also increases stiffness and stress resistance when compared to alloys in the same class and it improves 'quality', durability, inhibiting the re-crystallization of aluminum alloys showing improved resistance to hot cracking during welding.

Scandium's full potential has not been reached and much of the work was done in the Soviet Union and China in the latter decades of the Cold War years and before the collapse of the Berlin Wall in 1990, little about scandium was known beyond that boundary. The West worked more on titanium while the East Block saw scandium as its special ingredient. Scandium production is very expensive and very scarce; however, a little scandium goes a long way. Not so much as 0.5% added to aluminum can vastly enhance the properties of the resulting alloy, strengthening it and allowing for tighter and longer lasting welds.

Today, aerospace applications account for much of the interest in scandium; however, new promising uses have also been developed. Scandium is needed to produce solid oxide fuel cells used to generate electricity from natural gas or from renewable fuels. Thanks to the mechanical qualities of this alloy, some high-end bicycle manufacturers have been able to reduce the diameters of the frame tubes pipes at certain points, adding flexibility and reducing weight than traditional aluminum frames. However, until now, the lack of a reliable availability or production of scandium has limited its evident potential.

The aerospace industry remains one of the principal avenues for the development of this mineral. Airbus (EADS) has been studying scandium (specifically aluminum scandium zirconium – AlScZr alloys) because it would allow for the welding rather than riveting of the aircraft's surfaces, potentially achieving a 10% weight reduction (improving fuel consumption). The largest deposit of scandium was recently discovered in Australia during excavations in the former Greenvale nickel

mine on the outskirts of Townsville in North Queensland.

The current market price of the rare element has been around USD 5,000 per kilogram, depending on the quantity and purity and Metallica Metals ('Metallica', ASX: MLM) is using a long term price of USD 2,000/kg of high purity scandium oxide in their feasibility studies. Andrew Gillies, Managing Director of the company, reveals that the quantity and quality of the deposits of scandium is impressive. "Scandium" – said Gillies – "is present in many rocks, usually in a ratio of 5 to 15 parts per million and very rarely enriched, but here it is ten to a hundred times more concentrated." Metallica's project, a high grade scandium and cobalt-nickel project (known as SCONI) could be "world's first commercial exploitable scandium deposit" according to Gilles. Much like 'Dirty Harry', scandium is truly a maverick among rare earths.